

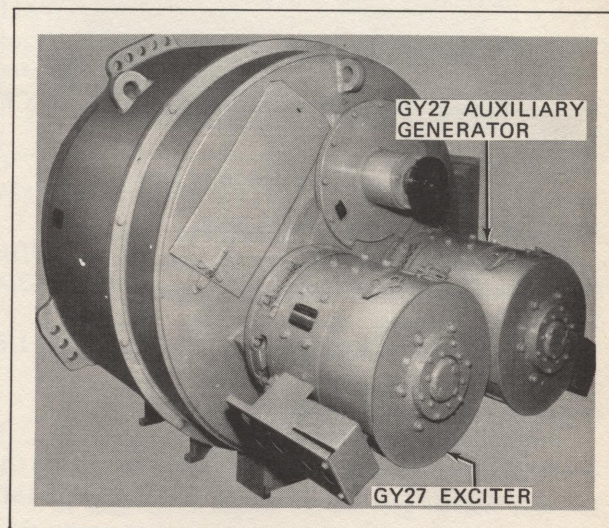


INSTRUCTIONS

ROTATING EQUIPMENT

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FIG. IV-1. TRACTION ALTERNATOR
WITH AUXILIARIES.

TRACTION ALTERNATOR

DESCRIPTION

The Type GTA11 Traction Alternator is a salient-pole, three-phase, Y-connected alternating-current generator which converts the mechanical energy of the locomotive diesel engine into the electrical power required for locomotive propulsion. The a-c output of the alternator is converted to d-c by means of a rectifier panel and used as the power supply for the d-c traction motors.

The GTA11 alternator is a single-bearing, separately-excited machine which is directly connected to the diesel engine. The engine crankshaft supports approximately half the weight of the alternator rotor. The other half is supported at the outboard end by means of a roller bearing which is splash-lubricated from the auxiliary-drive gear unit.

INTRODUCTION

This section is a brief description of electrical rotating apparatus on a locomotive such as the traction alternator, the auxiliary generator/exciter and the traction motor. For a detailed analysis, refer to the applicable maintenance manual furnished with the locomotive.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

Excitation is supplied by an exciter, Fig. IV-1, mounted on and driven by the alternator through the auxiliary-drive gear system. Also shown in Fig. IV-1 is the auxiliary generator which supplies power for the control system.

A simplified schematic diagram of the GTA11 alternator is shown in Fig. IV-2.

DATA

Type	GTA11
Classification	10-pole, three-phase, Y-connected a-c generator
Rotation (facing collector-ring end)	CCW
<u>Brushes</u>	
Quantity per machine	6
Type	Speer 524
Minimum Length (length at which brush becomes inoperative) (in.)	1-3/16
Brush-Arm Pressure (new brush) (lb.)	4-1/4 to 4-3/4
<u>Brushholder</u>	
Clearance to Collector Ring (in.)	3/32 to 1/8
<u>Lubrication</u>	
Auxiliary-Drive Gear Case Capacity (initial filling, approximately) (pt.)	5
Lubricant (low-foam type)	SAE-40 Engine Lube Oil GE-D6B-18D

LUBRICATION

The alternator roller bearing is splash-lubricated from the auxiliary-drive gear unit. No other lubrication is required.

Check the oil level in the auxiliary-drive gear unit by means of the dipstick located on the lower right-hand side of the gear case (facing collector end) between the exciter and the alternator framehead.

If the engine is shut down, read the oil level on the side of the dipstick marked Generator Stopped. If the engine is idling, read the oil level on the side of the dipstick marked Generator Running. Maintain the oil level between the FULL and ADD marks on the dipstick.

CAUTION: Do not overfill gear case. Overfilling may result in oil being drawn through the alternator bearing onto the collector rings and windings, and cause serious operating difficulty.

Drain the gear case once a year or after 180,000 miles of operation, whichever occurs first, and refill with SAE-40 engine lube oil, GE Specification D6B-18B.

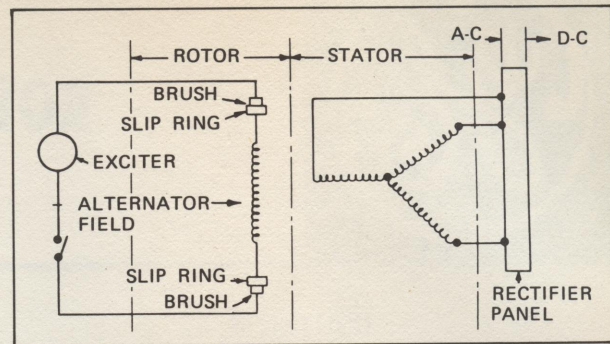


FIG. IV-2. SCHEMATIC DIAGRAM FOR GTA11 ALTERNATOR.

INSPECTION

In general, the inspection schedule of the alternator should conform to the inspection schedule established for the overall locomotive, but may be modified as required by actual operating experience.

The following information is offered as a general inspection guide which calls attention to what should be inspected and what to look for when making the inspection. If the inspection results call for corrective maintenance to be performed, the procedures for carrying out such maintenance are covered in the Maintenance Procedures section.

General

Make a visual inspection for evidence of loose or missing auxiliary and auxiliary gear-case mounting bolts, bolts which hold the electrical connection box cover in place, loose, damaged or missing latches in inspection covers. Also check for oil leakage from the auxiliary-drive gear unit and around the auxiliary mounting flanges. Make sure the gear unit oil-drain plug is tight.

Brushes

1. Inspect for wear, and replace brushes which have reached their minimum permissible length of 1-3/16 in., or which may be too short to run until the next inspection. When checking brush length, measure from the top of the brush clip to the center of the curved surface that is in contact with the collector ring.
2. Look for chipped or broken brushes, brushes with loose or frayed pigtails, and replace such brushes as necessary.

FIG. IV-3, E-13698

FIG. IV-4, E-13699

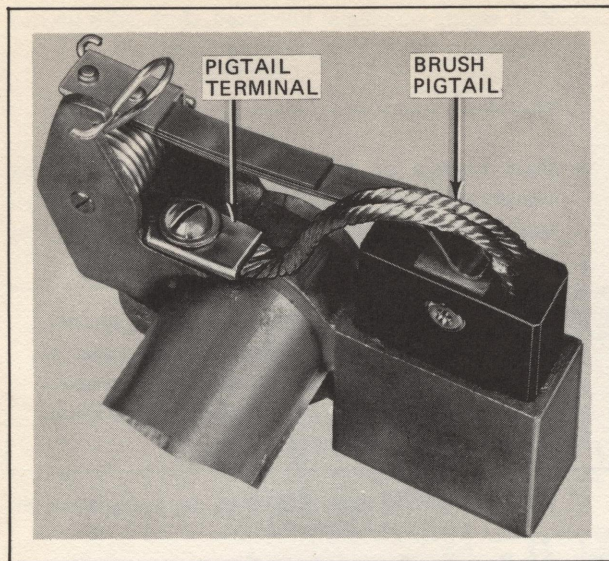


FIG. IV-3. CORRECT POSITION OF BRUSH PIGTAIL AND TERMINAL.

3. Make sure the pigtail terminals are positioned as shown in Fig. IV-3 and that pigtail terminal screws are tight.
4. Move brushes up and down several times in the brushholders to release carbon dust or foreign matter from the carbonways, which may prevent free movement of the brushes.

Brushholders

1. Check for loose, broken, bent or overheated pressure arms. Overheating will cause arms to become discolored and result in improper brush-arm pressure.
2. Make sure the thumb loop on the coiled brush pressure spring is in the position shown in Fig. IV-4.
3. Inspect brushholder mounting and make sure the studs are tight.
4. Check brushholder-to-collector ring clearance ($3/32$ to $1/8$ in.) and adjust as necessary.

Collector Rings

1. Wipe off insulation between rings with a clean, dry cloth and inspect for evidence of physical damage.
2. Check the surface of the collector rings for evidence of discoloration, etching, grooving, threading or other signs of distress that may require corrective action. To help determine the need for such action, the

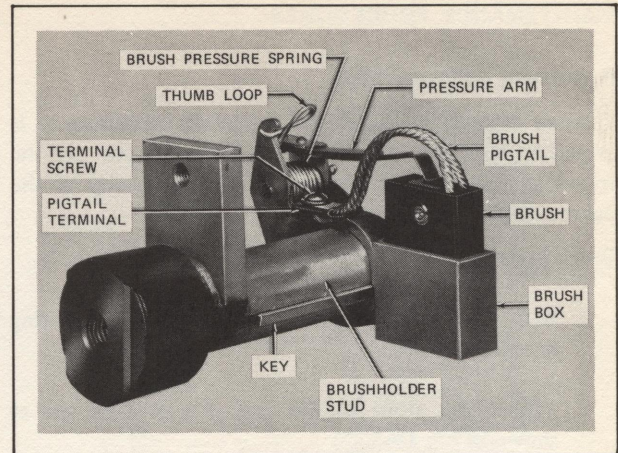


FIG. IV-4. BRUSHHOLDER ASSEMBLY.

following information is offered as an inspection guide. Ideally the collector ring surface should have a uniform, chocolate-brown color and be free of etching, threading or grooving. Conditions encountered in service, however, including oil vapors, adverse humidity conditions and air contaminants of various kinds add to the difficulty of maintaining an ideal collector ring surface.

If dark spots appear on the ring surface, they will likely be at uniform brush spacing. These spots later turn to a grayish color accompanied by etching of the collector ring surface. If appropriate action is taken at this point, that is, as soon as the dark spots appear or no later than the first evidence of the grayish, etched condition, more serious problems can be avoided later by removing the distressed areas with a brush seater stone as described under Maintenance Procedures section.

Without corrective action, severe arcing and grooving of the collector ring with resultant rapid brush wear, follow quickly until the grooving extends over 180 degrees or more of the ring surface. This requires the rings to be ground in order to remove the burned spots and grooving, and to restore the ring surface to a true circle.

Bus Rings and Field Leads

Check for cracked, frayed or damaged insulation.

Field Coil Connection Straps

Inspect insulation for evidence of cracks or physical damage that may require corrective action.

MAINTENANCE PROCEDURES

Resurfacing Collector Rings

When inspection reveals that corrective maintenance is required, resurface the collector rings by one of the following two methods depending on the severity of the burned spots or grooving:

Brush Seater Stone

1. With engine shut down, remove all collector ring brushes.
2. Tape seater stone to the end of a stick for use as shown in Fig. IV-5.

WARNING: Projections from the end of the rotating field leave insufficient clearance above the rear (inboard) collector ring for use of a hand-held stone. To avoid serious injury, resurface rings only with a stone taped to the end of a stick.

3. Start the engine and run it at idle speed.
4. Apply enough pressure to the seater stone to produce the cutting action required to remove the dark or burned spots.
5. Shut down the engine to inspect the ring surface. If further stoning is required, repeat Steps 2 and 3 and continue doing this until ring surfaces are clean.

WARNING: When using compressed air for cleaning purposes, an environment potentially hazardous to personnel in the immediate area is created. To prevent physical injury by flying debris, observe all Railroad and OSHA safety regulations.

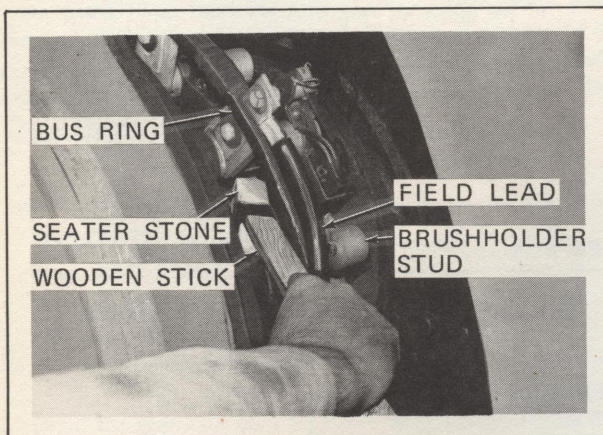


FIG. IV-5. RESURFACING COLLECTOR RINGS WITH BRUSH SEATER STONE.

6. With engine running at idle speed, clean collector ring surfaces by use of clean, dry compressed air.
7. Shut down engine and reinstall brushes.
8. Sand brushes to remove metal which may have transferred from collector ring to the brush contact surface. Use a strip of 2-in. wide by 24-in. long fine-grit sandpaper for this operation.

WARNING: When using compressed air for cleaning purposes, an environment potentially hazardous to personnel in the immediate area is created. To prevent physical injury by flying debris, observe all Railroad and OSHA safety regulations.

9. Blow out carbon dust with clean, dry compressed air.

Collector Ring Grinder

See Fig. IV-6 for collector ring grinder drawing.

1. With engine shut down, remove all brushes from brushholder.
2. Remove the two collector bus rings (with field leads attached) so they will not interfere with the grinder installation or the grinding operation.
3. Remove the two brushholders (Nos. 5 and 6) from the brushholder yoke located on the right-hand side of the alternator facing the collector end. Mark or label the studs to reduce the possibility of reassembling them in the incorrect position.
4. Attach the grinder (without stones installed) to the brushholder yoke in the No. 6 brushholder position by means of the No. 6 brushholder stud capscrew as shown in Fig. IV-7. The grinder mounting bracket is designed so that once it is attached to the yoke, no further alignment is required.
5. Adjust the radial-feed stop to prevent the grinder way from damaging the collector ring if the stone wears too short.
6. Install stone in right-hand (inboard) support and a dummy stone in left-hand (outboard) support. Clamp stone at the proper angle to permit full travel of the stone across the ring surface. If burning or grooving is severe, start with a medium-grade stone and change to a fine-grade stone for the finishing operation.

NOTE: Grind only one ring at a time. Final ring diameters need not be the same.

FIG. IV-6, E-14107

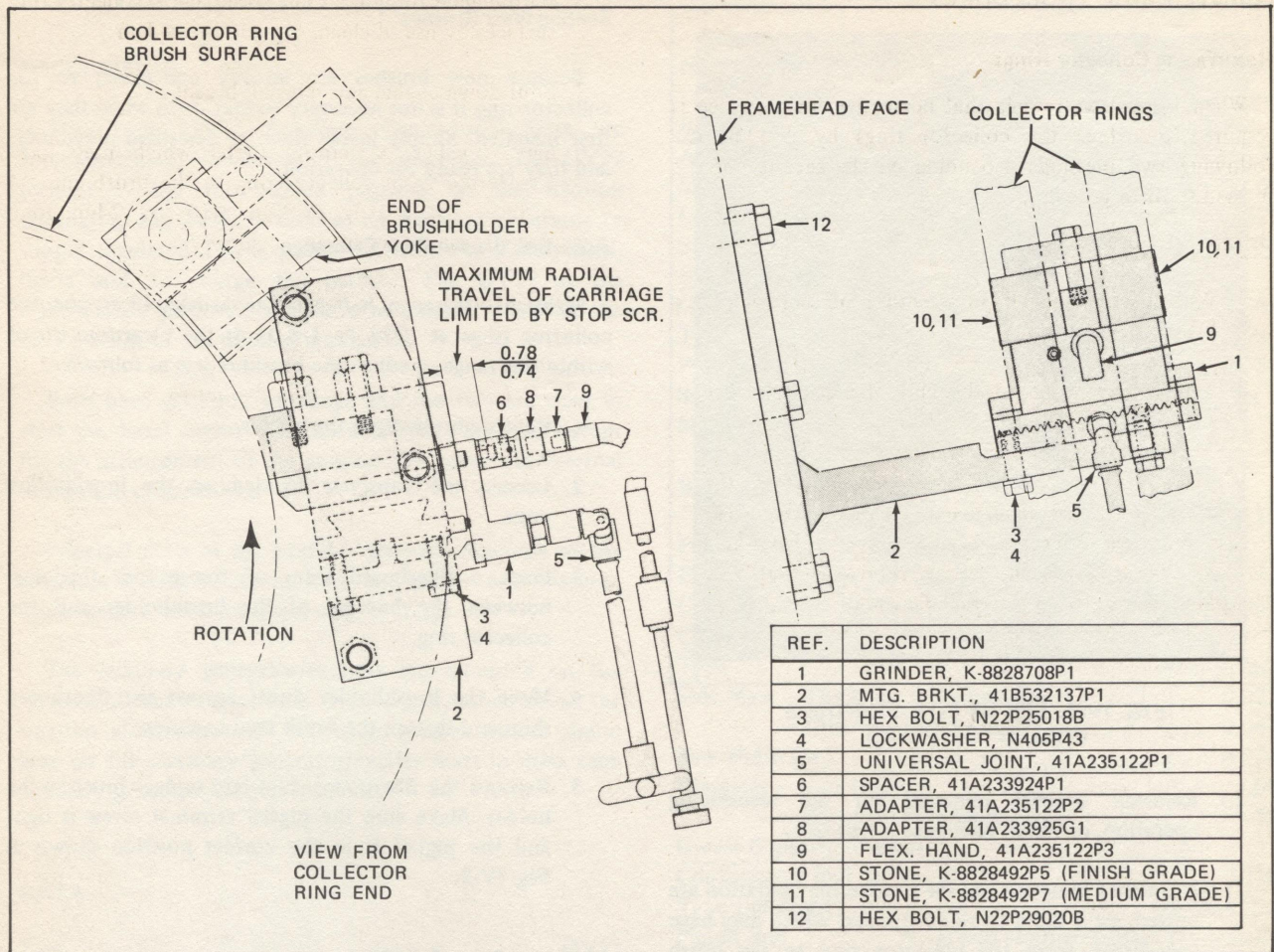


FIG. IV-6. COLLECTOR RING GRINDER.

7. Start engine and run it at idle speed.
8. Feed the stone radially inward by means of the feed screw until the stone makes contact with the collector ring surface.
9. Traverse the stone back and forth across the ring surface by means of traverse knob. Alternately continue feeding the stone inward slowly as it wears, and traversing the ring.
10. Periodically shut down the engine to check progress of the grinding operation. Repeat Steps 7, 8 and 9 as many times as necessary to remove burned spots or grooving. Change to fine-grade stone for the finishing operation.
11. With the grinding operation completed and the engine shut down, remove the grinding fixture. Be careful not to nick or scratch the rings.

WARNING: When using compressed air for cleaning purposes, an environment potentially hazardous to personnel in the immediate area is created. To prevent physical injury by flying debris, observe all Railroad and OSHA safety regulations.

12. Restart the engine and, with alternator running at engine idle speed, blow out the alternator with dry compressed air. Direct the air so as to remove grinding dust from the stator windings and field coils.
13. Shut down the engine and reinstall brushholder studs in their original position.

CAUTION: Failure to install brushholder studs in their correct position will result in short circuiting the collector rings when excitation is applied.

14. Reinstall the bus rings and field leads.

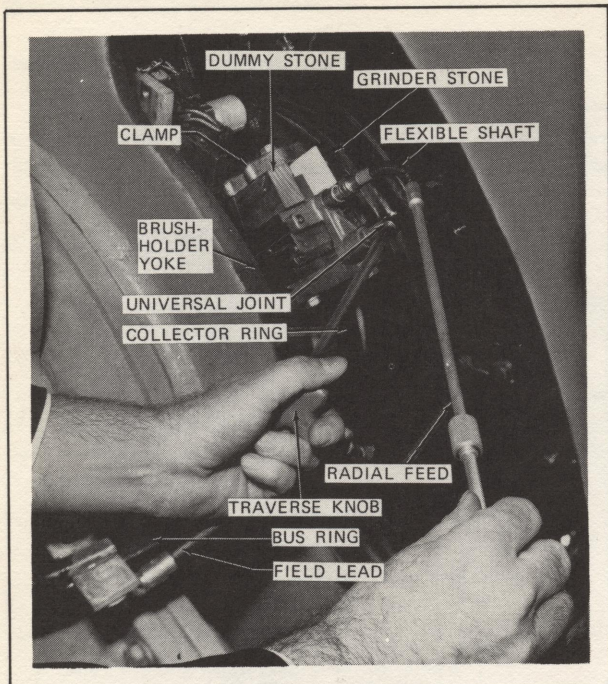


FIG. IV-7. SET-UP FOR GRINDING COLLECTOR RINGS.

15. Reinstall brushes removed for the resurfacing operation, or install new ones if necessary.
16. If brushes removed for the resurfacing operation are reused, sand them to remove metal which may have transferred from the collector ring to the brush contact surface. Use a strip of fine-grit sandpaper 2-in. wide by 24-in. long for this operation.

Installing New Brushes

CAUTION: When installing new brushes use the GE recommended grade. Do not mix brush grades. Mixing brush grades in the same alternator or changing to another grade can seriously affect the collector-ring surface film and result in short brush life.

Install new brushes as follows, see Fig. IV-4:

1. Insert brushes in the holder with the pigtail connection on the side farthest away from the pigtail terminal screws.
2. Position the pigtail terminal under the terminal screw so that the terminal is parallel to the brush pressure arm.
3. Tighten terminal screw and latch the brush pressure spring.

Seating New Brushes

Because new brushes are already contoured to the collector ring it is not necessary to seat them when they are first installed. Simply install them as described previously, and they are ready for operation.

Adjusting Brushholder Clearance

Maintain clearance between the brushholders and the collector rings at $3/32$ to $1/8$ in. If the clearance is not within this range, readjust the brushholders as follows:

1. Remove brush from the holder.
2. Loosen the capscrew located on the brushholder yoke.
3. Place a fiberboard shim of the proper thickness between the bottom of the brushholder and the collector ring.
4. Move the brushholder down against the fiberboard shim and tighten the brush stud capscrew.
5. Remove the fiberboard shim and replace brush in the holder. Make sure the pigtail terminal screw is tight and the pigtail is in the correct position shown in Fig. IV-3.

Reversing Brush Polarity

To increase life expectancy of the collector rings and brushes, periodically reverse the polarity of the brushes by interchanging the two exciter leads inside the alternator connection box or at the brushholder.

Because conditions which adversely affect collector ring and brush life vary so widely, brush polarity reversals should be made every six months until operating experience indicates that satisfactory wear rates can be obtained by reversing the polarity less frequently.

High-Potential Testing

It is customary to apply an annual ICC high-potential test to the complete locomotive power circuit which includes all traction motors, the traction alternator, auxiliaries, locomotive wiring and associated switching apparatus. For the procedure to be followed in making this test and the precautions to be taken to protect equipment and personnel, refer to the appropriate section in the overall locomotive maintenance manual.

FIG. IV-7, E-13701

AUXILIARY GENERATOR/EXCITER

DESCRIPTION

The Type GY27 Auxiliary Generator/Exciters are force-ventilated, shunt-wound, d-c machines. The GY27 located at the four o'clock position on the traction alternator, Fig. IV-8, is used as an auxiliary generator to supply regulated 75-vdc power to the control equipment, lights and to charge the battery. The GY27 at the eight o'clock position, is used as an exciter to control the field current of the traction alternator.

Both have cranking windings, and the two are used to start the diesel engine. The two models are the same except for the arrangement of the commutator covers for external ventilation connections.

Principal parts of the auxiliary generator/exciters are the armature assembly, commutator and pinion end bearings, brushholders, field coils, and magnet frame.

The auxiliary generator/exciters are mounted on the traction alternator gear box. A drive gear, mounted on the traction alternator shaft extension, meshes with a pinion gear on the auxiliary generator/exciter shaft to drive each auxiliary generator/exciter machine.

DATA

Type	GY27
Rotation	CW
Max. Speed (rpm)	2900
Full Speed (rpm)	2400

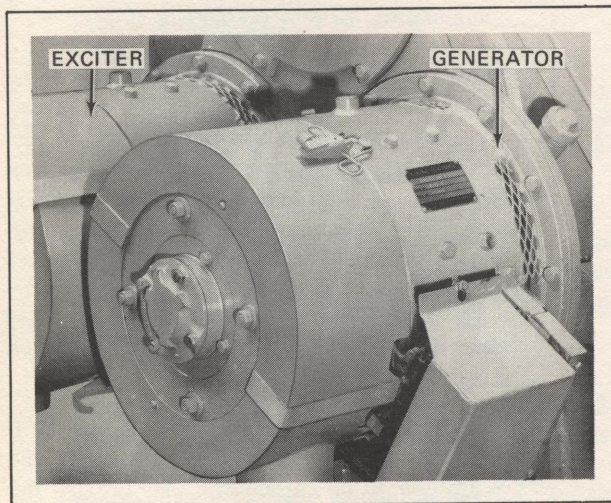


FIG. IV-8. TYPE GY27 MOUNTED ON TRACTION ALTERNATOR, TYPICAL.

Classification	four-pole, commutating pole, force-ventilated, shunt-wound, d-c generator
Nominal Rating	12 kw, 75 v at 850 rpm 51 kw, 250 v at 2400 rpm

Resistances at 25 C (Ohms)

Armature	0.0229
Shunt Field	11.05
Commutating Field	0.00872
Starting Field	0.00665

Brush Data

Grade	GE-T-583
Type	Duplex with Rubber Pad
Pressure (oz.)	43 to 53
Size (in.)	0.50 x 1 x 2
Minimum Length (length at which brush becomes inoperative) (in.)	1

Brushholder Clearance to

Commutator (in.)	0.06 to 0.10
------------------------	--------------

Pole Bores (Average)

Exciting Poles (in.)	9.844
Commutating Poles (in.)	10.098

Commutator Data

Type	Arch-Bound
Side Mica — Thickness (Nominal) (in.)	0.022
— Grooving Depth (in.)	0.047
Saw Width (in.)	0.024
Diameter — New (in.)	8.00
— Minimum Permissible (in.)	7.50

Grease Capacity of Bearing

Commutator End (oz.)	3-1/8
Type Lubricant	GE-D6A2C4
Pinion End	No grease required (splash lubricated)
Weight (lb.)	695

WARNING: Electric shock can cause serious or fatal injury. To avoid such injury, personnel should take and observe proper precautions during high-potential testing.

SPECIAL TOOLS AND EQUIPMENT

The following items are required to maintain, repair and overhaul the auxiliary generator/exciter.

	GE Part No.
Commutator Grinder	8843613G3
Resurfacing Stones	8828492P4

LUBRICATION

The pinion-end bearing is lubricated by oil splashed in the traction-alternator gear box. Maintain the oil level in the gear box between the HIGH and ADD marks on the dipstick.

Periodically repack the CE bearing as follows:

1. Remove the bearing cap and examine the old grease for evidence of steel chips. This would indicate bearing damage.
2. Repack the bearing cap with approximately 2 oz. of D6A2C4 grease.
3. Replace the bearing cap.

INSPECTION

1. Inspect brushes to be sure they are not worn near the minimum length, chipped or broken. Replace worn or damaged brushes. Also replace others in same brushholders since longer brushes are probably defective (did not share load equally).

CAUTION: *When replacing brushes, use the GE recommended grade. Mixing of brush grades in the same machine or changing brushes to another grade is not recommended as this will seriously affect commutation, surface film, commutator and brush life.*

2. Inspect brushholders for damage from burning or arcing. Check for damaged pressure springs or levers; replace parts as necessary.
3. Inspect the condition of the commutator. Be sure it has a smooth, polished surface. Clean and resurface when necessary. See section on Commutator Resurfacing.
4. Inspect all leads and connections. Be sure the connections are tight.
5. Measure the insulation resistance of the armature and field coils with a megohmmeter.

COMMUTATOR RESURFACING

When the commutator becomes worn, grooved, or burned, it may be resurfaced with a commutator grinder without removing the machine from the locomotive or the armature from the machine. Rotate the armature in its own bearings.

Resurfacing of a commutator is done with commutator grinder assembly, Part 8843613G3 and stones listed in Special Tools and Equipment section.

Resurfacing On Locomotive

WARNING: *An environment potentially hazardous to personnel in the immediate area is created when resurfacing. To prevent physical injury by flying debris, observe all Railroad and OSHA safety regulations.*

1. Remove any oil and dirt from the exposed insulation surfaces around the commutator, using an approved method.
2. Remove the four o'clock brushholder assembly and the A1 connection strap on the generator, Fig. IV-8, or the two o'clock brushholder assembly on the exciter. Lift all the other brushes on the machine being resurfaced.
3. Install the commutator grinder in the auxiliary generator/exciter as follows, Fig. IV-9:
 - a. Assemble the grinder to the mounting bracket with two 3/8-16 by 1-3/8 in. hex bolts and lockwashers.
 - b. Bolt this assembly in the machine where the brushholder was removed. The key on the end of the bracket fits into the keyway on the end of the frame. Then insert the 5/8-11 by 1-1/2 in. hex bolt through the frame (with the flat washer under the head), screw the hex bolt into the hole in the bracket and tighten.
 - c. Install two resurfacing stones on the grinder. Space them far enough apart to cover the entire width of the commutator surface when the carriage is moved from side to side. For small commutators, use only finish-grade stones.
 - d. Adjust the holder on the bracket so each stone travels parallel to the surface of the commutator. To adjust, slightly loosen the two 3/8-16 hex bolts. Check by inserting a feeler gage between the surface of the commutator and each stone at each end of their travel along the commutator. This check should be made at unworn sections of the commutator and at both ends or between the brush paths. After adjustment, back the stones away from the commutator and tighten the two mounting bolts.
4. Place the locomotive Reverse handle in the OFF position. Have the Generator Field Breaker in the OPEN position so no current will pass through the machine being resurfaced. The engine can be started by cranking with one machine only.

FIG. IV-9, E-25153

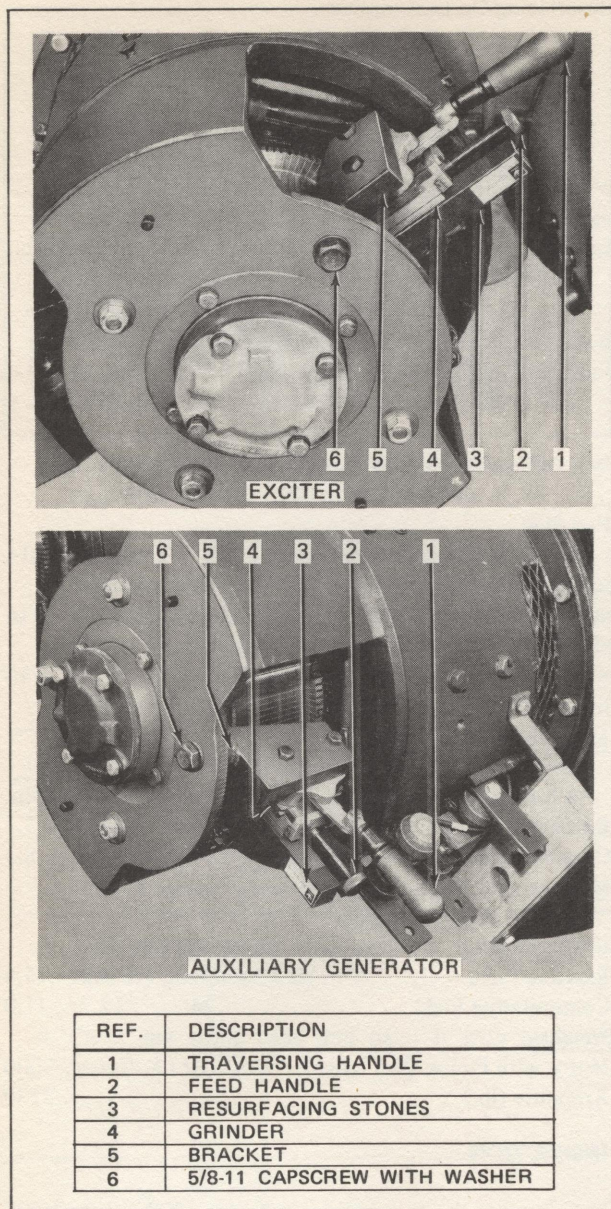


FIG. IV-9. COMMUTATOR GRINDER INSTALLED IN GY27 MACHINES.

5. Start the engine and let it run at IDLE until it runs smoothly. This operation may be performed immediately after a locomotive returns from a run, while the engine is still warm.
6. Advance the stones to take a light cut across the commutator surface and to check alignment before proceeding with the operation. Stones should cut approximately the same amount at the front and the riser ends of the commutator where the brush paths are not worn in the surface. If the amount of the cut

is not the same, readjust the grinder until the cut is approximately even at both ends of the commutator.

7. Traverse the grinder and advance the stones until the commutator is clean. Begin with light pressure and increase it no more than necessary. Do not take too deep a cut, for this will result in an excessive amount of copper being dragged over the edges of the commutator bars. If possible, use a vacuum-cleaning device to collect the copper and abrasive dust during the grinding operation.
8. Make a light finishing cut. Then, without changing the feed, traverse the commutator several times to obtain a good, smooth finish.
9. Shut down the engine and remove the grinder from the auxiliary machine.
10. Using an engraving tool, remove any ragged edges from the commutator bars and fins of copper which have dragged over the slots.
11. If necessary, undercut the slot mica between the segments with a 0.024 in. thick saw.
12. Clean the commutator slots to remove mica and grinding dust with a stiff nylon bristle brush. A new paint brush or stencil brush with bristles cut short for added stiffness is satisfactory.

WARNING: When using compressed air for cleaning purposes, an environment potentially hazardous to personnel in the immediate area is created. To prevent physical injury by flying debris, observe all Railroad and OSHA safety regulations.

13. Start the engine and run it at IDLE. Thoroughly blow the commutator and interior of the machine with dry, compressed air to remove all copper filings and dust. Polish the commutator with fine sandpaper.
14. Shut down the engine and measure the commutator runout with a dial indicator mounted on the frame. The indicator should have a sensitivity of 50 divisions, 0.001 in. or smaller, for one revolution of the pointer. Maximum allowable runout after stoning is 0.001 in.
15. Replace the brushholder assembly that was removed and the A1 connection strap, if it was removed. Replace brushes, as necessary, with the GE recommended grade.

TRACTION MOTOR

DESCRIPTION

The Type GE752 Traction Motor, Fig. IV-10, is a four-pole, commutating-pole, series-wound d-c motor designed for locomotive propulsion. Its normal function is to convert the electrical energy supplied by the traction generator into mechanical power for driving the locomotive wheels.

The traction motor is coupled to the locomotive axle through a reduction gear system housed in a gear case. The gear case is attached to the traction motor and surrounds a pinion and gear. The gear case excludes dirt and moisture and holds the necessary gear lubricant.

Locomotives equipped with dynamic braking use the traction motors as generators to retard the rate of travel when descending grades or slowing down the train.

DATA

Type	GE752
Maximum Permissible Speed	2445
Resistances at 25 C (Average) (Ohms)	
Armature	0.01002
Exciting Field	0.00555
Commutating Field	0.00592
Brush Data	
Pressure (lb.)	10-12
Size (Duplex) (in.)	3/4 by 2-1/4 by 2 long
Minimum Lenght (length at which brush becomes inoperative) (in.)	
	1-3/32
Brushholder Clearance to Commutator	1/16-3/32
Commutator	
Side Mica — Thickness (in.)	0.060
— Grooving Depth (in.)	3/64-5/64
Diameter — New Commutator (in.)	16-5/8
— Minimum Permissible (in.)	15-3/8
Riser — Width Minimum Permissible (in.)	5/8
Pole Bores (Nominal — measured at center of poles)	
Exciting Poles (in.)	19.640
Commutating Poles (in.)	19.970
Bearings (Assembled)	
Diametrical Clearance	
Armature Bearings	
Commutator End (in.)	0.0017-0.0057
Pinion End (in.)	0.0025-0.008
Axle Bearings	
Minimum New (in.)	0.014
Maximum Worn (in.)	0.060

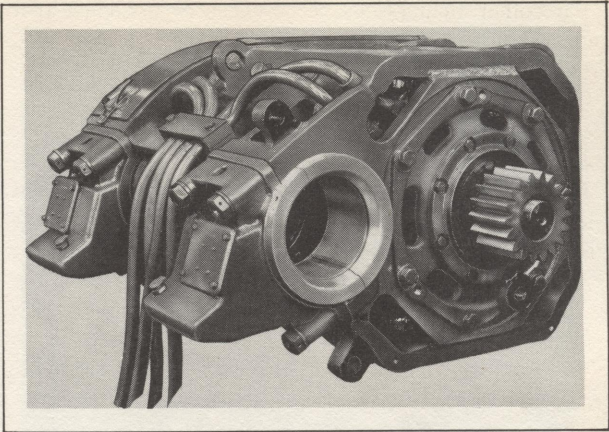


FIG. IV-10. TRACTION MOTOR.

FIG. IV-10, E-9288

End-Play			
Armature Bearings — New (in.)	0.005-0.014		
Axle Bearings			
New Linings (in.)	1/16		
Worn Linings (1/8 in. max. wear per lining flange) (in.)	5/16		
Impedance of Field Circuits			
Measure before assembly of			
armature: 60 cycles a-c		Volts	
to hot field coils only	Amps	Max.	Min.
Exciting Field	24	14.8	13.7
Commutating Field	24	9.6	8.3
Measure with brushes lifted			
and armature assembled:			
60 cycles a-c			
Exciting Field	24	17.6	15.6
Commutating Field	24	12.7	11.0
Weights			
Motor with Pinion (lb.)	7000		
Armature (lb.)	2170		

INSPECTION

1. Inspect the commutator and wipe off the string band. The commutator surface must be free of copper beads and have a smooth, polished surface. Clean and resurface the commutator when necessary.
 2. The brushholder mechanisms must operate properly. Shunts and terminals must be tight and insulators clean.
 3. Inspect the brushes for physical appearance and amount of wear. Replace any which are chipped, broken or worn near the minimum length of 1-3/32 in.
- Brushes must move freely in their holders and be free of dirt, carbon dust or other foreign material.

CAUTION: When replacing brushes, use the GE recommended grade. Mixing of brush grades in the same machine, or changing brushes to another grade, could seriously affect commutation, surface film and brush life.

4. Check and adjust the spring pressure. Inspect the clearance between the bottom of the brushholder and the commutator support. See Data section.
5. Examine the armature and field coils for cracked, charred or broken insulation. See that field coil connections are tight.
6. Examine the flash ring for damage. Keep the flash ring clean and free of paint or insulation.
7. Measure the insulation resistance with a megohmmeter. If a reading of less than one megohm is indicated, a further inspection to determine insulation failure or excessive moisture should be made. Correct the cause of low megohmmeter readings before placing a motor back in service.

WARNING: When using compressed air for cleaning purposes, an environment potentially hazardous to personnel in the immediate area is created. To prevent physical injury by flying debris, observe all Railroad and OSHA safety regulations.

8. Blow out the motor thoroughly, in both directions, with dry compressed air.
9. Clean the string band and paint it with insulating varnish A15B17A if needed.

CAUTION: Do not apply insulating varnish over dirt. Dirt or other contaminants will provide a current leakage path under, as well as over, varnish.

10. Measure end-play of the motor on the axle and diametrical clearance of the axle linings. See Data section for permissible limits of wear. Measure as follows:

- a. To measure the end-play, move the motor toward the gear by barring between the nose suspension and truck bolster. Measure the end-play (lateral clearance) through the drain hole in the axle-flange dust guard located at the commutator end. Use feeler or go-no-go gage as shown in Fig. IV-11. If gear lubricant has frozen the pinion to the gear so the motor cannot be barred sidewise, add clearance at each end of the motor to get the total lateral clearance. Clearance at the pinion end can be measured between the gear hub and the axle-lining flange by inserting a feeler through the drain hole in the gear-case seal.
- b. Another method of measuring end-play is to clamp an indicator to the commutator end of the axle cap so that the pointer rests against the wheel, Fig. IV-12. Force the motor as far as it will go one way along the axle. Set the indicator at zero. Force the motor in the other direction as far as it will go and read the lateral clearance or end-play. When this clearance equals or exceeds the permissible amount, install new linings. See Fig. IV-13 for a method of measuring diametrical clearance of axle linings.

FIG. IV-11, E-6025

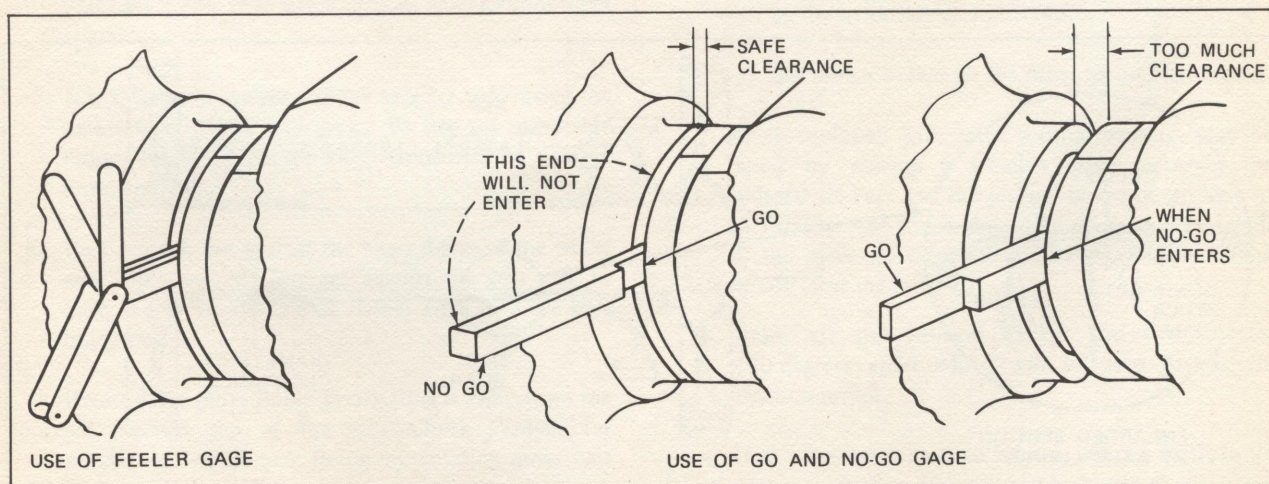


FIG. IV-11. MEASURING END-PLAY.

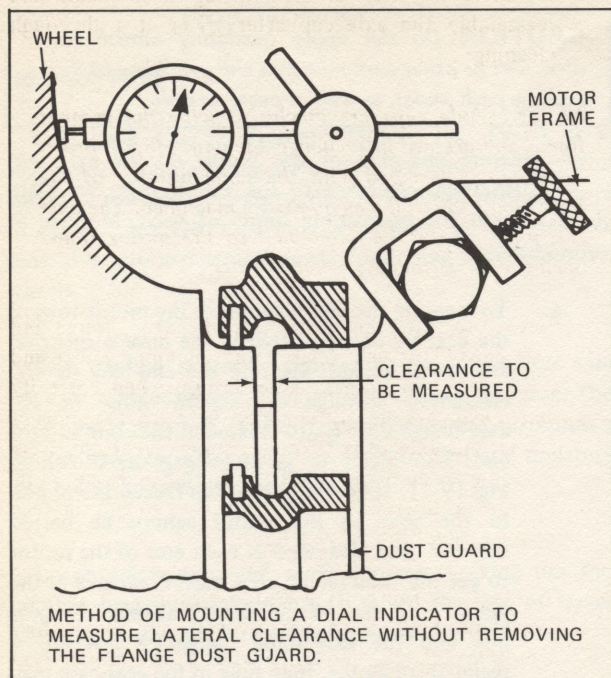


FIG. IV-12. USING DIAL INDICATOR TO MEASURE END-PLAY.

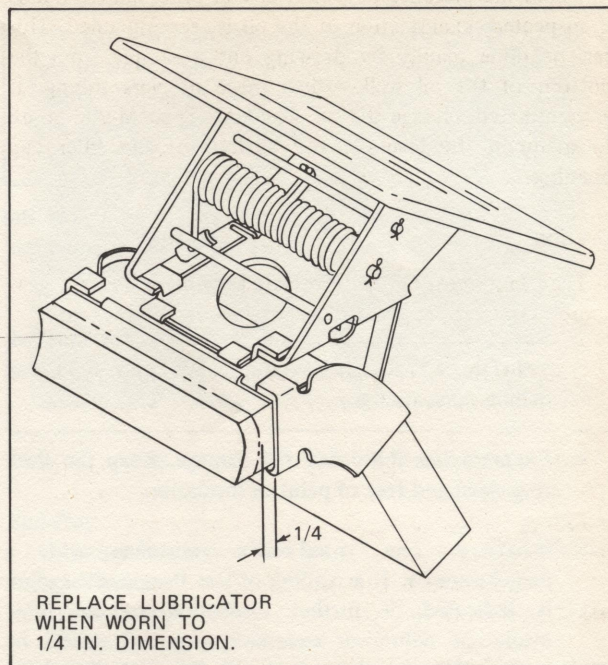


FIG. IV-14. CONDEMNING LIMIT FOR FELT WICK LUBRICATOR.

FIG. IV-12, E-6026

FIG. IV-13, E-6027A

FIG. IV-14, E-8502A

11. Remove the felt-wick lubricators and examine them for the following defects:

- a. Wear in excess of 1/4 in., Fig. IV-14.
- b. Burned or hardened wick surface which is no longer absorbant.
- c. Damaged wick or wick holder.

LUBRICATION

Armature Bearings

Roller bearings are packed at the time of motor assembly with ball-bearing grease GE Spec. D6A2C4. No access is provided for the addition of grease during the operation of the motor between overhaul periods.

Axle Bearings

The motor is equipped with large oil capacity axle caps having felt-wick lubricators to conduct the oil to the axle and bearing.

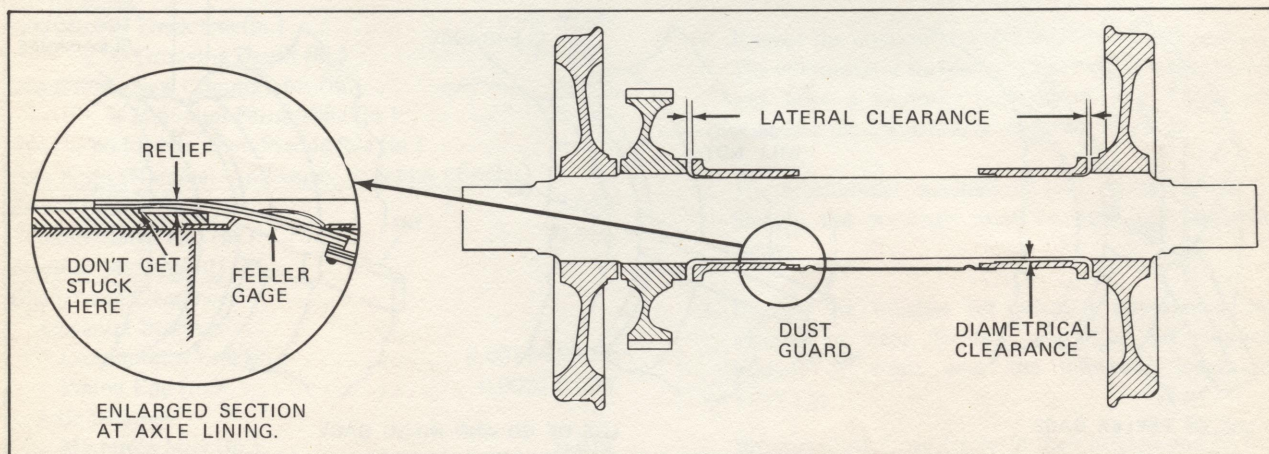


FIG. IV-13. MEASURING DIAMETRICAL CLEARANCE OF LININGS.

Where the presence of water, dirt or other contaminants is suspected, examination of the oil is recommended. This can be done readily by drawing out a sample from the bottom of the oil well with a piece of glass tubing. If contaminated, change the oil. Use AAR Spec. M-906-56 oil to maintain the level to the bottom of the filler cap opening.

Gearing

The spur gearing is lubricated with a heavy gear compound GE Spec. D50E8C contained in the gear case.

CAUTION: *Never permit the gears to run dry. The result will be extreme wear of gear and pinion teeth.*

CAUTION: *Do not overfill the gear case. Doing so may cause the gear compound to enter the armature bearing and cause bearing failure.*

REPLACING AXLE LININGS ON THE LOCOMOTIVE

To replace axle linings without removing the motor from the truck, place the truck over a pit, drain oil from axle caps, remove the flange dust guard, axle caps and the axle dust guard. Replace as follows:

1. Use a pinch bar to force the motor towards the commutator end so clearance will be maintained for easy removal of pinion-end lining.
2. Remove the three gear-case mounting bolts.
3. Loosen the bolts that hold the two sections of the gear case together and allow the bottom half to drop about 1 in.
4. Insert two 3/4-in. pieces of wood between the gear-case halves (one piece at each end) to hold them apart.
5. Lift the motor weight off the axle by supporting the axle side of motor with jacks. To free the inner axle lining, force the motor away from axle by using a jimmy bar.
6. Rest a pinch bar against the inner flange of the wheel and apply enough leverage against the gear case to raise it free from the axle lining. Then, roll the axle lining out.
7. Remove the inner lining by rotating it away from the key around top of the axle. Check journals for roughness. Install new lining by rotating inner half into position over the top of the axle.

8. Install outer half of new lining in position and reassemble the axle cap after giving it a thorough cleaning.

NOTE: *Axle caps are machined with the magnet frame and are not interchangeable with other motors. Each cap is stamped with the serial number of the frame with which it was originally machined. The axle cap must always be assembled to the motor frame having a corresponding serial number.*

Never use shims between faces of magnet frame and axle caps. This will destroy the clamping effect and result in loose linings. Axle linings, when correctly assembled, are tightly clamped between the magnet frame and axle caps to prevent movement and wear on the outside diameter of the linings. Axle cap bolts are drawn down until the face of the cap and the face of the magnet frame are a tight fit.

9. Tighten axle cap bolts at 800 lb.-ft. torque. Lubricate axle cap bolts with white lead and oil before tightening. Lock the bolts with wire through bolt heads. Replace the dust guards and fill the caps with four qt. of AAR Spec. M-906-56 car oil. Replace the gear case and add 12 lb. of GE Spec. D50E8C lubricant.

RESURFACING COMMUTATOR IN THE LOCOMOTIVE

Locomotive Preparation

1. Place the locomotive over a pit.
 - a. Cut out the air brakes on the truck requiring motor maintenance.
 - b. Block wheels on the axles not being worked on so the locomotive cannot move.
 - c. Set the air brakes on the other locomotive trucks.
2. Axles equipped with roller journal bearings may be raised by placing a wooden block between the pedestal tie bars and the journal boxes of the axle to be rotated. The block should be thick enough to fill all the space. Jack up the end of the truck until the wheels clear the rails.
3. Raise all the brushes except the two, located 180 degrees apart which will be used to run the traction motor.
4. If the diesel engine is to be run, insert a baffle in the motor air duct so dust will not be blown about.

WARNING: An environment potentially hazardous to personnel in the immediate area is created when resurfacing. To prevent physical injury by flying debris, observe all Railroad and OSHA safety regulations.

5. Install commutator grinder, Part 8837582G1, in the bottom commutator opening located on the suspension side. This is the safest place and will allow most of the grinding dust to fall out. See Fig. IV-15. The grinder assembly consists of a "Midget" grinder, K-8828708G1 (Part 100X371), mounting bracket, Part 8843149P6, resurfacing stones, Part 8824492P8, and various capscrews and set screws as indicated on Fig. IV-16. Install the grinder as follows:

- a. Bolt the grinder to mounting bracket with four capscrews (6), Fig. IV-16.
- b. Remove the cover from the bottom inspection hole on the suspension side.
- c. Install the grinder in the motor by bolting it into the cover bolt holes. Use two capscrews and lockwashers (4 and 5) provided with the fixture. The base of the mounting bracket will be on the outside of the frame.
- d. Place the two jam nuts (9) on the set screws (8) and screw them into the tapped holes in corners of the base of the mounting bracket. These adjust the position of the grinder with respect to the commutator.
- e. Install medium-grade resurfacing stones in the grinder, Fig. IV-15.

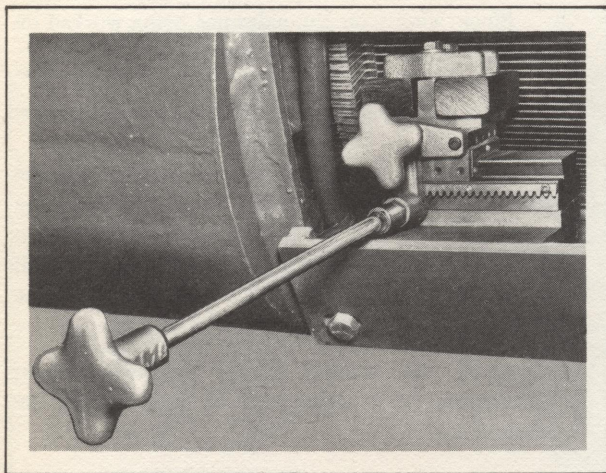


FIG. IV-15. MIDGET COMMUTATOR GRINDER INSTALLED IN GE752 MOTOR.

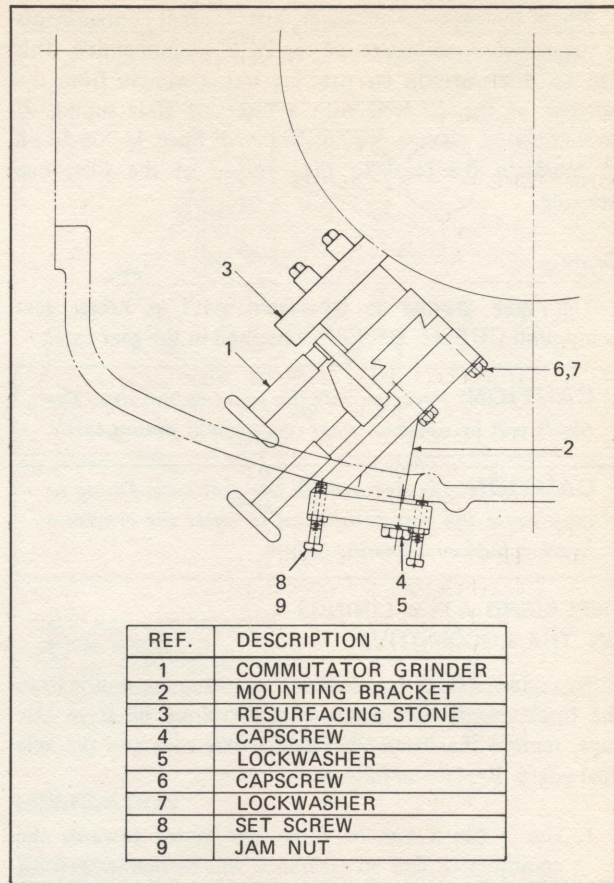


FIG. IV-16. COMMUTATOR GRINDER PART 8837582G1.

- f. After the stones are installed, traverse the grinder to one end of the commutator and check clearance between the commutator surface and one stone with a feeler gage. Traverse the grinder to the other end of the commutator and check the clearance under the same stone. The clearance should be the same at both ends. If the clearance is different, adjust the mounting bracket by means of the set screws (8) until the clearances are the same at both ends. When clearances are the same, tighten the jam nuts (9) on the set screws to maintain adjustment while grinding.
 - g. Turn the feed control to back the stones away from the commutator while the motor is being started.
6. Connect the motor to a source of controlled power to drive it at a speed of 1000 to 1500 rpm. This power can be obtained from an outside source of power or from the locomotive power plant.

FIG. IV-15, E-10677

FIG. IV-16, E-5981

FIG. IV-17, E-671A

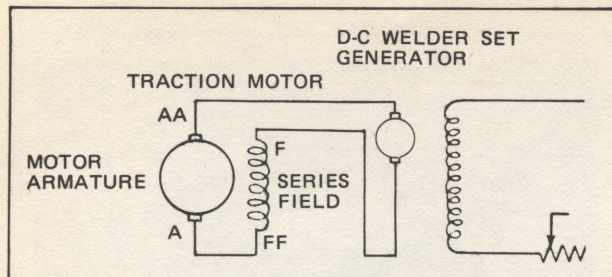


FIG. IV-17. DIAGRAM OF CONNECTIONS TO RUN TRACTION MOTOR FROM WELDING SET.

- a. Disconnect the motor leads from the locomotive wiring and connect motor as a series motor to an outside source of power such as a 3 to 5 kw at 100 v welding set if an outside power supply is to be used. See Fig. IV-17.
- b. The motor can also be run from the diesel-electric locomotive power plant. With all wheels blocked except those connected with the motor to be worked on, the motor can be run for stoning the commutator without disturbing locomotive connections by placing the Throttle handle in the first operating position. Current required to run the motor is so low no damage will result to the blocked stationary motors through which current will flow.

WARNING: To protect personnel from physical harm, following safety precautions must be adhered to:

Block the locomotive wheels to protect the locomotive from moving during the grinding operation. Make blocking positively secure.

A second person must be at the power control station ready to shut-off power in case of an emergency during the grinding operation.

The grinding operator should wear goggles and a dust mask when grinding or blowing out the commutator.

7. Apply power to the traction motor and gradually bring the speed up to 1000 to 1500 rpm.
8. Move the fixture back and forth along the commutator while slowly advancing the stones toward the commutator surface. Use extreme caution in advancing the stones to obtain a fine cut and to avoid chatter.

NOTE: Use the medium stones for the rough cuts. For finishing, use fine stones and run the motor in the opposite direction.

9. Grind the commutator until a uniformly smooth surface is obtained and all flat spots have been removed. Do not remove more copper than necessary.
10. After the final cut, traverse the stones back and forth longitudinally without changing the feed until there is no more cutting action.
11. Remove power from the motor and remove the grinding fixture.
12. Scrape the slots between the bars to remove projecting mica fins or copper whiskers.

WARNING: When using compressed air for cleaning purposes, an environment potentially hazardous to personnel in the immediate area is created. To prevent physical injury by flying debris, observe all Railroad and OSHA safety regulations.

13. Run the motor again at 1000 rpm and polish the commutator with 00, or finer, sandpaper. Blow dust from the commutator and interior of the motor with dry compressed air. Hold the end of the hose about one or two inches from the commutator surface and sweep longitudinally to blow away copper chips and loose mica.
14. Remove power and make the necessary mechanical and electrical changes to place the motor back in service on the locomotive.
15. Install new brushes.

NOTE: Do not grind the commutator to a depth where the mica undercut has been removed.

COMMUTATOR MAINTENANCE

DESCRIPTION

The commutator, Fig. IV-18, is a vital part of every d-c motor and generator; therefore, it deserves the very best care. The fact that a commutator usually shows signs of distress before trouble actually occurs, is a big help to the maintainer. If you can recognize these signs and know what to do, you can often correct the trouble before it becomes serious.

A commutator has three functions:

1. It provides the required sliding electric contact between the fixed brushes and the moving armature to remove or apply electrical energy to the machine.

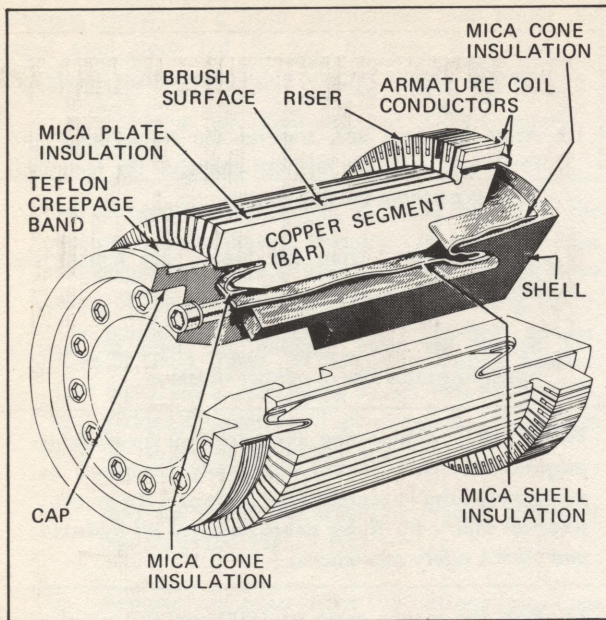


FIG. IV-18. CUTAWAY SECTION OF THE COMMUTATOR.

2. It acts as a reversing switch. As the ends of the armature coils pass the brush positions, the commutator switches them from one circuit to another where the current is flowing in the opposite direction. Thus all the coils have current flowing through them in the proper direction at all times.
3. It also brings the voltage of each armature coil in the circuit to the brush surface. These voltages add up bar by bar between brushes. As a result, the total operating voltage of the machine appears at the brushes.

CONSTRUCTION

A commutator, Fig. IV-18, is formed of alternate copper segments and mica plates. Copper segments are often called bars so hereafter, in this publication, we will use the term bar instead of segment.

The mica plates physically separate and electrically insulate the bars and provide arch pressure essential to commutator stability. The plates are undercut below the commutator surface to prevent interference with the sliding action of the brushes on the surface of the commutator.

The bars are wedge shaped and form a cylinder when assembled. Each bar has a riser at one end to make armature coil connections.

The bars are held in position by the clamping action of a steel cap bolted to a steel shell, Fig. IV-19.

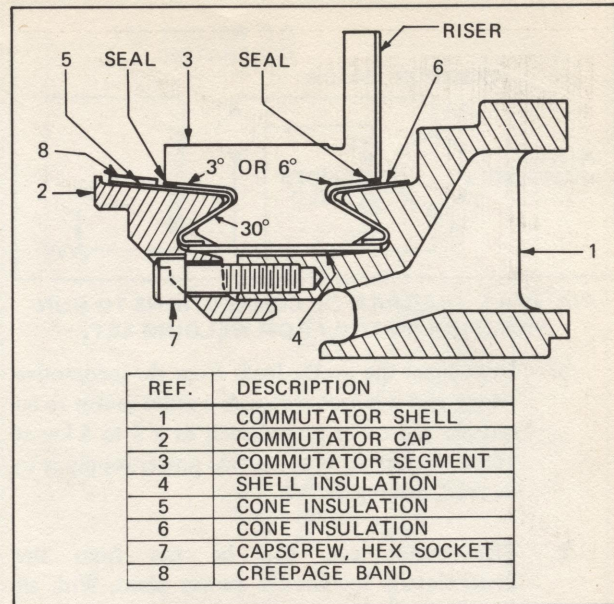


FIG. IV-19. ARCH-BOUND COMMUTATOR ASSEMBLY.

Mica cones, contoured to fit between the shell and cap, insulate the bars from ground (armature).

A Teflon* creepage band, applied on the exposed cone insulation, protects the mica from damage and presents a smooth creepage surface that is easy to keep clean.

SURFACE CONDITIONS

A commutator cannot work properly unless the brushes make good electrical contact. This requires a smooth, polished, cylindrical surface that runs true with its center.

Surface Film

The successful operation of all d-c machines depends on maintaining a proper film on the surface of the commutator, Fig. IV-20. This film of carbon, graphite, copper oxide and water vapor is deposited on the commutator surface by electrochemical action. It is formed by the wiping action of the brush against the commutator and by the normal current flow between the brush and the commutator.

The importance of maintaining a proper commutator surface film cannot be overemphasized. With this film established and properly maintained, good brush performance (reduced brush and commutator wear) and satisfactory commutation (no destructive sparking) is assured. Changes in color from copper to deep brown or chocolate should give no cause for worry, as long as the surface is smooth and has a polished glossy appearance.

*E.I. du Pont de Nemours and Co., Inc.

FIG. IV-20, E-8761A

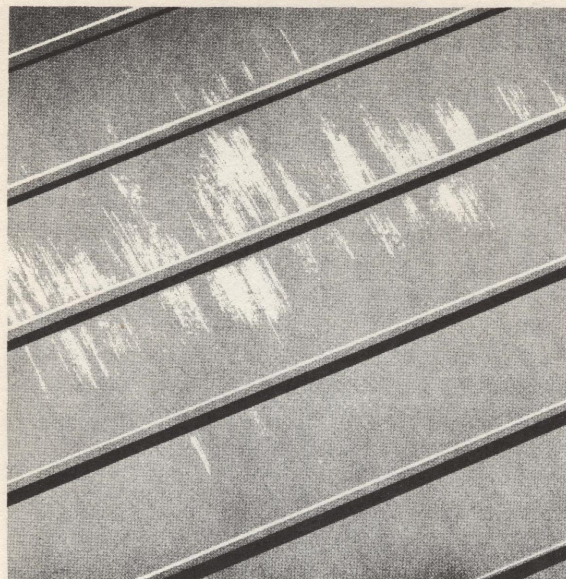


FIG. IV-20. GOOD COMMUTATOR FILM OF UNIFORM COLOR.

FIG. IV-21, E-8762A



FIG. IV-21. ONE LIGHT — TWO DARK, THREE-COIL PER SLOT COLOR PATTERN.

Color Pattern

This term indicates only that the color of the commutator bars is not uniform and a definite pattern exists. The pattern is almost always related to the arrangement of coils in the armature slots. In itself, this condition is not a sign of damage. The color pattern may show up in several sequences, Figs. IV-21 and IV-22. As long as there is a definite pattern around the whole commutator, do not be concerned.

A check for surface damage should be made at scheduled commutator inspection periods. If no damage exists, no further action is required.

Marking, Etching and Flat Spots

The following conditions indicate discoloration and/or etching of commutator bars — but in varying degrees. Possible causes of etching and discoloration include:

1. Excessive load on the machine
2. Electrical adjustment off; such as, wrong shims behind commutating poles or wrong interpole gap
3. Wrong brush grade
4. Uneven or rough commutator surface
5. Contaminated atmosphere

6. Incorrect brush spacing

7. Incorrect brush shift.

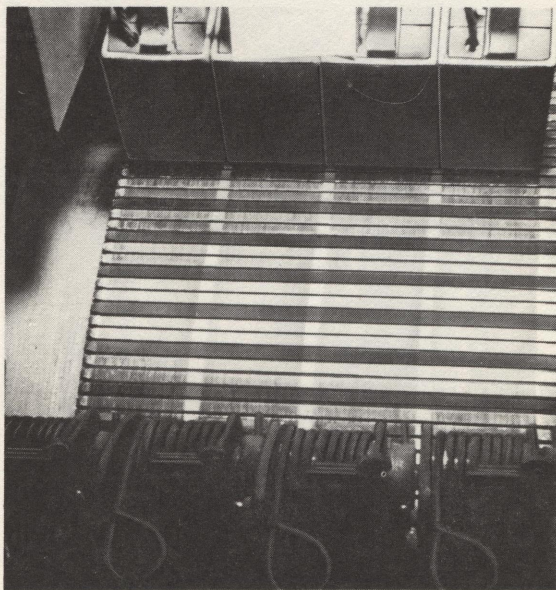


FIG. IV-22. ONE DARK — TWO LIGHT, THREE-COIL PER SLOT COLOR PATTERN.

FIG. IV-22, E-8763

The best way to overcome these conditions is to determine the cause and make the necessary corrections. If damage has not progressed too far, it may clear itself once the cause has been eliminated. If it is determined that some resurfacing of the commutator is necessary, it should be done sparingly.

Marking

This condition appears as an opaque darkened surface or black deposit on the bars, usually at their trailing edge, with no etching or corrosion of copper underneath.

Check for this condition quickly by using a common pencil eraser to remove the deposit; then examine the copper surface for roughness or pitting. If none is seen, the condition is marking, which can readily be removed with a canvas cloth. See Fig. IV-23.

Bar Surface Etching

This condition gives the appearance of severe marking and a pencil eraser uncovers pitting, eroded or burned bar surfaces. Such a condition results from arcing between the brush and the copper commutator bars and the etching is usually visible with the naked eye when the marking is removed. See Figs. IV-24 and IV-25.

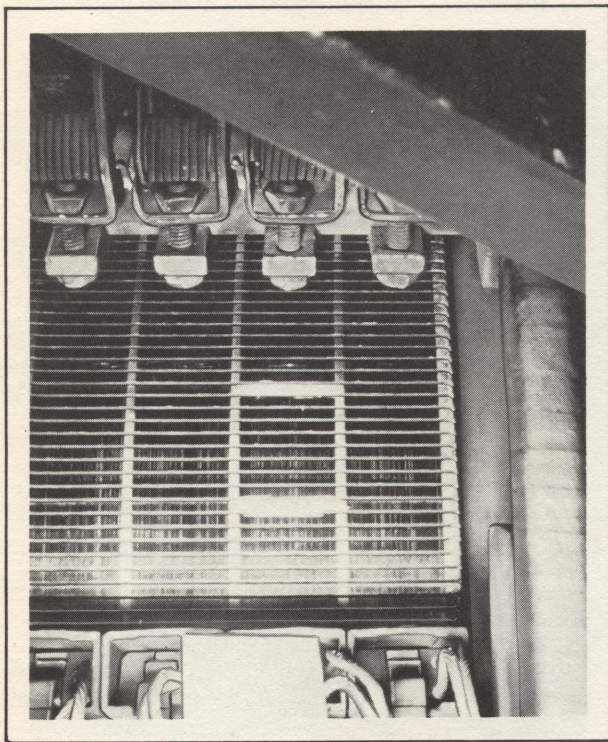


FIG. IV-23. COMMUTATOR FILM REMOVED WITH A PENCIL ERASER TO SHOW A SMOOTH COPPER SURFACE UNDERNEATH.

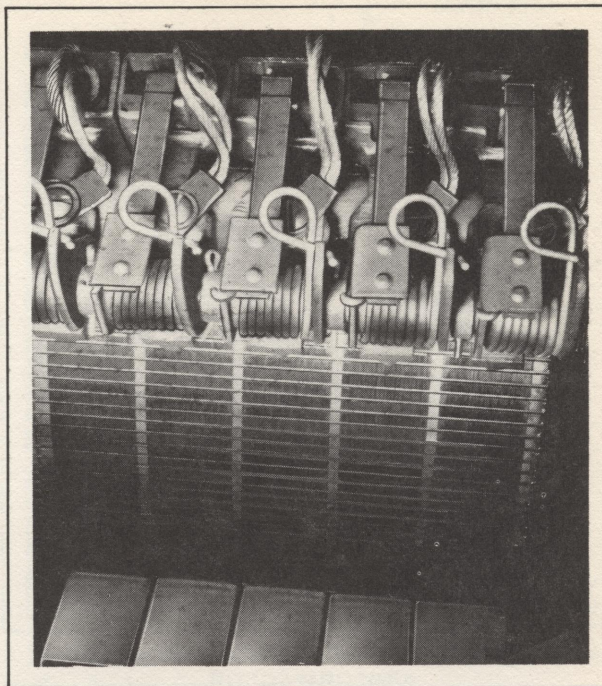


FIG. IV-24. HEAVY ETCHING ON A TWO-COIL PER SLOT COMMUTATOR.

Bar Corner Etching

When this condition prevails, the corner of the bar is eroded leaving a chamfered corner but little or no evidence of marking or bar surface etching.

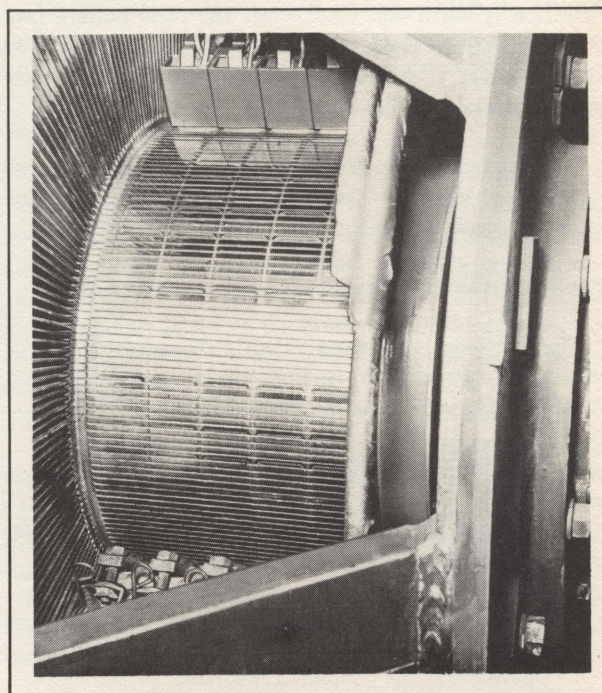


FIG. IV-25. IRREGULAR FILM AND ETCHING CAUSED BY A ROUGH COMMUTATOR.

FIG. IV-23, E-8764

FIG. IV-24, E-8765A

FIG. IV-25, E-8766

Bar corner etching may be best seen by holding a light source at an angle which will reflect light from a chamfered corner to the eye.

Flat Spots

If etching is not corrected and progresses too far, flat spots will develop. Flat spots may also develop from a mechanical disturbance, such as the vibration from a defective bearing. As a rule, however, flat spots result from failure to correct some faulty condition which is first indicated by burned bars. See Fig. IV-26.

Threading

Threading is a commutator surface condition that shows as circumferential grooves on the commutator. Threading is the result of abrasive or electro-chemical action of the brushes.

In light threading, grooves may be just barely apparent where the surface film or color is disturbed or different. In heavy threading, a rippled surface can be felt if you rub a fingernail along the surface of a bar. See Figs. IV-27 and IV-28.

The brush faces wear to fit these grooves. When the commutator shifts due to armature end-play, the brushes are lifted out of the grooves. Then contact between the brush and the commutator is disturbed, sparking occurs and commutation is disrupted.

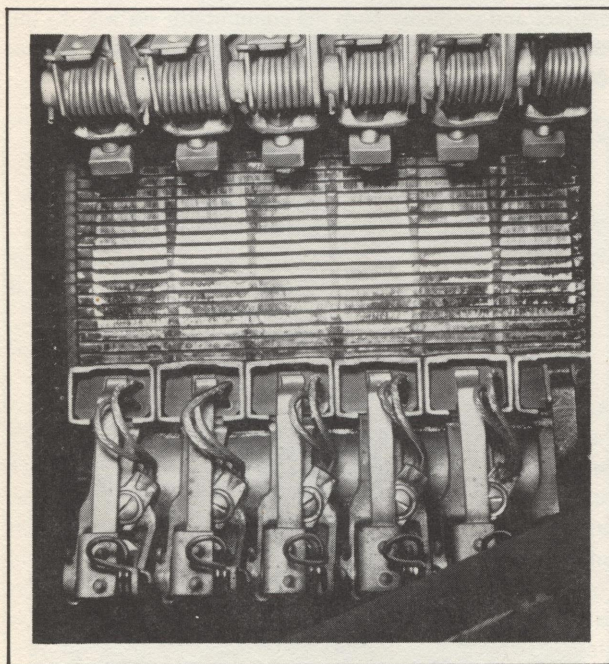


FIG. IV-26. FLAT SPOT ON A COMMUTATOR THAT ALSO SHOWS FLASHOVER DAMAGE.

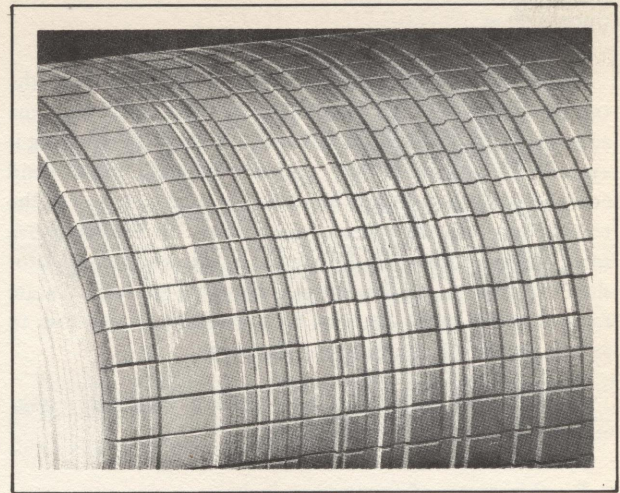


FIG. IV-27. HEAVY THREADING OF COMMUTATOR.

Possible causes of threading include:

1. Low current-density in the brush (machine is not heavily loaded).
2. Abrasive dirt or other foreign material imbedded in the face of the brush.
3. Mica flakes or copper imbedded in the brush face.
4. Wrong brush grade.

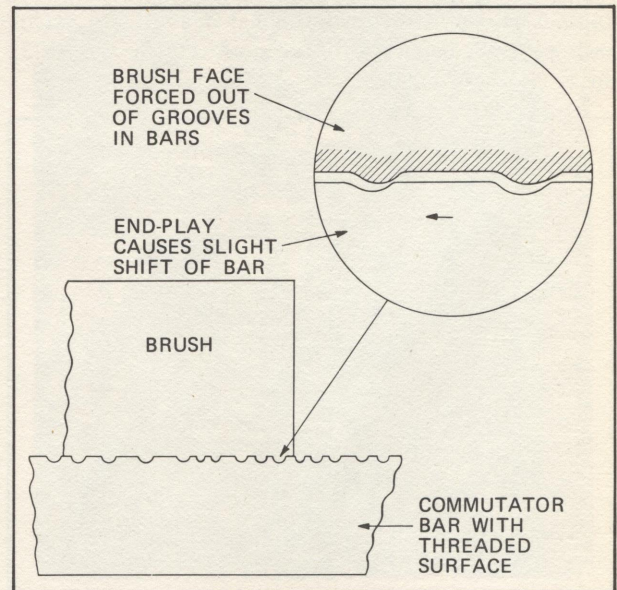


FIG. IV-28. ILLUSTRATION OF THREADING OF COMMUTATOR SURFACE.

Copper Drag

Under certain conditions copper is dragged over the trailing edges of the commutator bars and has the appearance of small metal flakes or feathers. Copper drag is caused by particles of copper, copper oxide and contaminates that do not bond firmly to the surface of the commutator. As the commutator rotates, the brushes shove small flakes of this material toward or into the commutator slots. This decreases the distance between the bars. An arc formed at any brush can then be more easily carried over to an adjacent brush resulting in a flashover.

Copper drag should not be confused with bar corner etching. See Figs. IV-29 and IV-30.

Possible causes of copper drag include:

1. Contaminated atmosphere
2. Copper imbedded in brush face
3. Hard spot in brush
4. Wrong brush grade
5. Excessive vibration
6. Low current density.

A temporary solution to copper drag is to clean the commutator occasionally with a light brush-seater stone. If drag has progressed too far, the slots must be raked and cleaned.

Banding

Banding is a surface defect in the form of bands around the commutator in which the surface film has been partially or completely removed. These bands may be quite narrow (not to be confused with threading) or they may extend over a sizeable percentage of the brush path. See Fig. IV-31 for example of banding.

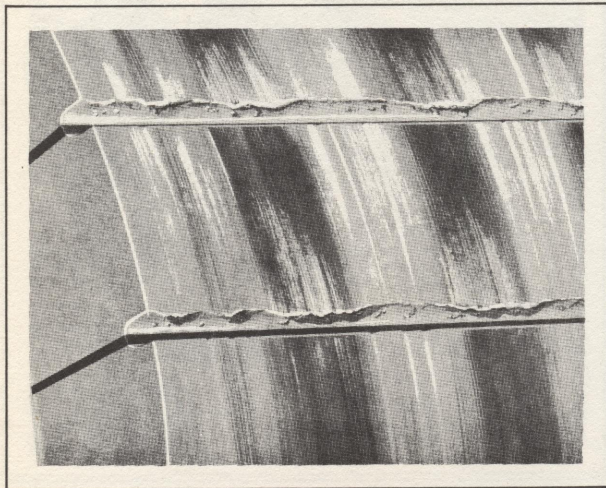


FIG. IV-29. COPPER DRAG ON TRAILING EDGE OF COMMUTATOR BARS.

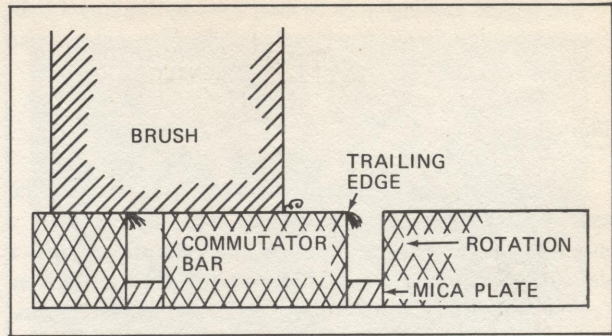


FIG. IV-30. ILLUSTRATION OF COPPER DRAG.

Possible causes of banding include:

1. Brush film too heavy (film tears from surface)
2. One brush is the wrong grade
3. Hard spot in a brush.

Banding can be corrected by hand-stoning after the cause has been eliminated.

Eccentricity

Even though a commutator surface is smooth, it can be running off center. This is a common fault and is usually the easiest of all surface variations for the brushes to follow. They simply rise and fall in the holders with each revolution. However, as speed goes up, this eccentric motion becomes faster. Finally, the brushes begin to break contact and gradually burn the commutator surface. As this continues, the burning causes still further surface destruction. See Fig. IV-32.



FIG. IV-31. EXAMPLE OF BANDING.

FIG. IV-29, E-8769A

FIG. IV-30, E-8770

FIG. IV-31, E-8771

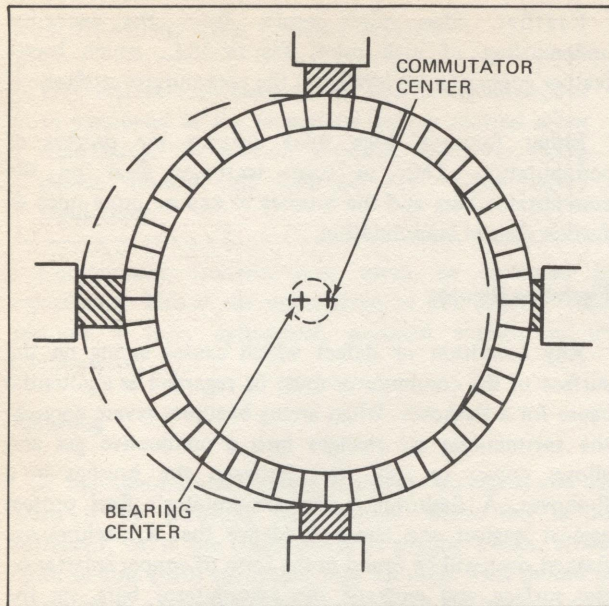


FIG. IV-32. EXAMPLE OF ECCENTRIC COMMUTATOR (EXAGGERATED FOR PURPOSES OF ILLUSTRATION).

Possible causes of eccentricity include:

1. Bent shaft
2. Bearings not running true
3. Commutator machined on bad shaft centers
4. Distortion caused by wide temperature changes and high speed
5. An offset coupling in single bearing traction generators.

Determine the cause of eccentricity and resurface the commutator using a rigidly-mounted grinding fixture. Eccentricity cannot be corrected by hand-stoning.

Surface Breaks

Sometimes a sharp step occurs on a commutator surface. This may be caused by a bump or blow to the commutator. Though the change in surface level may be very small, not even a heavy spring load will keep the brush in contact with the depressed bars. The brush may "ski-jump" from the higher level or, if rotation is reversed, the step strikes the brushes and "kicks" them away from the surface. This causes sparking, followed by electrical erosion and flat spots on the surface of the commutator. At high speed this kick may be hard enough to shatter the brushes. See Fig. IV-33.

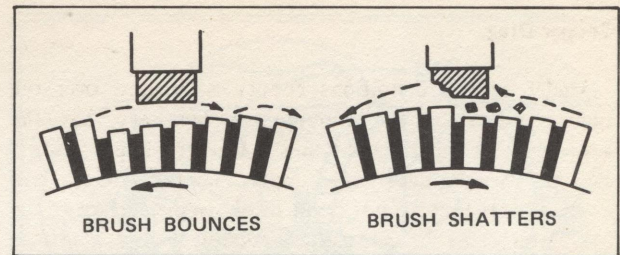


FIG. IV-33. EFFECTS OF DEPRESSED BARS AND REVERSAL OF ROTATION.

Possible causes of surface breaks include bumping of commutator surface during handling or striking commutator with a heavy tool, etc.

Resurface the commutator with a rigidly-mounted grinding fixture to remove the surface break.

High Bars

If a motor armature does not rotate while power is applied, the commutator bars under the brushes will overheat and expand. Expansion will cause these bars to rise above the adjacent bars. When the armature rotates, the high bars kick the brushes which, in turn, arc and burn the commutator surface. If this condition is not corrected, the brushes may shatter and a flashover could occur. See Figs. IV-34 and IV-35.

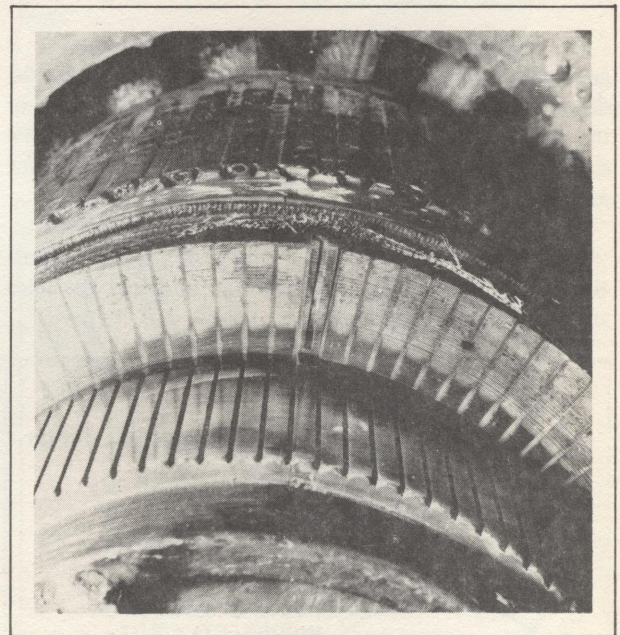


FIG. IV-34. EXAMPLE OF A SOFT COMMUTATOR BAR WHICH HAS LIFTED AT HIGH SPEED.

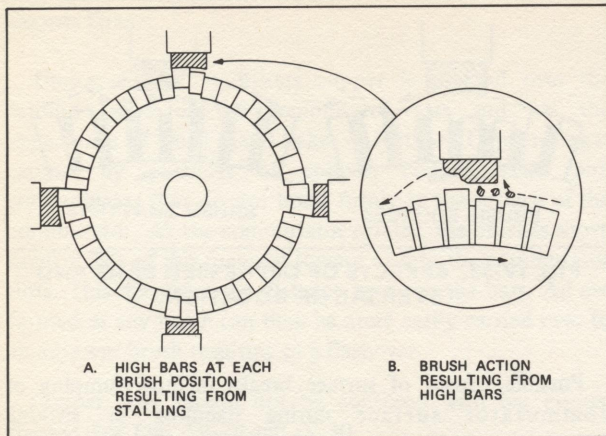


FIG. IV-35. EFFECTS OF HIGH BARS ON BRUSHES.

In severe cases, bar temperature may rise high enough to anneal the copper and destroy the binder in the mica plates. When this happens, flakes of mica will shift from the pressure areas and reduce the clamping action on the bars. Annealed bars wear differently than normal bars and being loose, will lift at high armature speed.

Annealed bars can be detected with a scleroscope or some equivalent means. Sometimes they can be spotted by discoloration of the bar ends outside the brush track.

High mica refers to the height relationship between the surface of the mica plate and the surface of the commutator bars. See Fig. IV-36-A for correct relationship.

In normal use, the surface of the commutator is gradually worn down. As the copper is worn away, the depth of the undercut (slots) is reduced until the edges of the mica plates are even with (or slightly higher than) the surface of the commutator, Fig. IV-36-B. At this point, the mica is called high mica.

High mica can be the result of either normal electro-mechanical wear, or failure to undercut the mica after resurfacing operations.

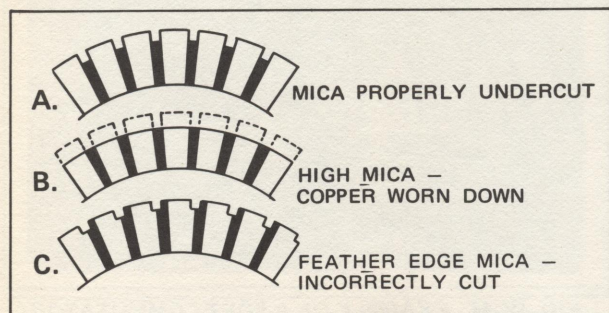


FIG. IV-36. HIGH OR FEATHER-EDGE MICA.

Feather edge mica results from the incorrect undercutting of high mica, Fig. IV-36-C, which leaves feather edges of mica level with the commutator surface.

Either form of high mica disrupts the process of commutation. This, in turn, increases wear on the commutator bars and the brushes to expose more mica to further disrupt commutation.

Flashover Damage

Any condition or defect which causes arcing on the surface of the commutator must be regarded as a potential cause for a flashover. When arcing becomes severe enough, the surrounding air changes into a conductive gas and allows power to spill over between the brushes in a flashover. A flashover is the commutator's final protest against neglect and abuse. Evidence that a machine has flashed over will be found in the form of copper splatter on the surface and ends of the commutator bars, on the brushholders and nearby insulation and on the frame as shown on Fig. IV-37.

If a flashover occurs, clean the commutator, the Teflon creepage band, and the brushholders. Examine these parts for damage and check the condition of the brush faces. Repair or replace damaged parts as necessary.



FIG. IV-37. EQUIPMENT BADLY DAMAGED BY FLASHOVER.

RESURFACING THE COMMUTATOR

WARNING: *An environment potentially hazardous to personnel in the immediate area is created when resurfacing. To prevent physical injury by flying debris, observe all Railroad and OSHA safety regulations.*

Commutator troubles may often be corrected by resurfacing. This is the name given to any process which restores a true, cylindrical, polished surface to the commutator.

Polishing

If the commutator surface is merely smudged, you can clean it by polishing with canvas. When this is not sufficient, or if the commutator is slightly rough, crocus cloth or fine (4/0) sandpaper may be used. This should be mounted on a wooden block curved to fit the surface of the commutator as shown in Fig. IV-38.

CAUTION: *Never use emery cloth on a commutator. The abrasive particles not only scratch the surface, but they are conductive and lodge between commutator segments. This leads to short circuits.*

Stoning

If the commutator surface is mildly grooved, etched, or burned, and only a small amount of copper has to be removed to correct the defect, a hand stone is most suitable. The stone should have a surface curved to fit the commutator. Also, it should be long enough to bridge the defect to be removed; otherwise, the stone will ride in and out of the defect and do nothing to correct it. The length of the stone will usually be limited by the space between brushholders. If there is not enough space, a brushholder should be removed to make room for a larger stone, Fig. IV-39.

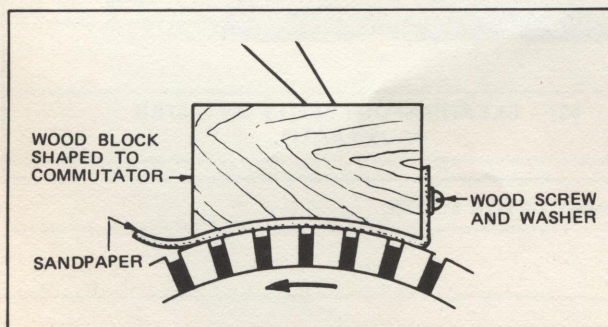


FIG. IV-38. FINE GRAIN SANDPAPER ON A SHAPED WOODEN BLOCK.

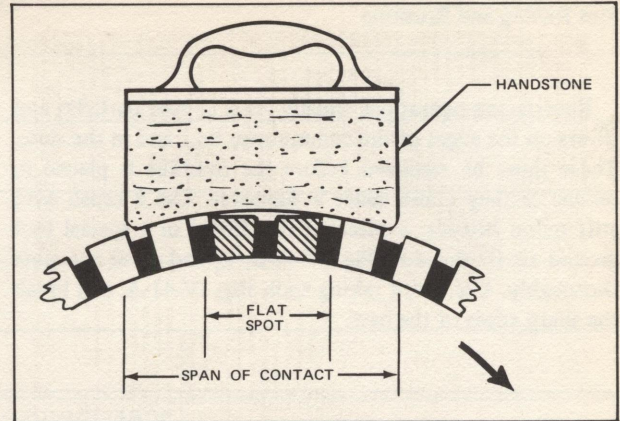


FIG. IV-39. PROPER USE OF HANDSTONE.

Hand stoning will not correct an out-of-round commutator. It is a fairly difficult operation and should be performed only by knowledgeable, skilled personnel.

Undercutting

After a commutator has been resurfaced, check the depth of the undercut of the mica between bars. If undercutting is necessary, it should be done carefully with a proper tool of correct size. The tool must have a sharp edge to cut the mica freely. A dull blade or saw produces small cracks in the mica into which dirt or moisture may find its way and break down the insulation between commutator bars.

Some common mistakes are shown in Fig. IV-40. Avoid these mistakes, refer to the device instruction book for the slot width and depth dimensions.

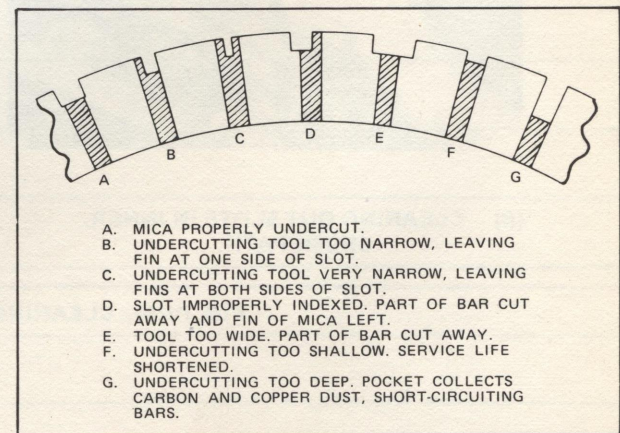


FIG. IV-40. COMMON MISTAKES IN UNDERCUTTING THE MICA BETWEEN COMMUTATOR SEGMENTS.

Slot Raking and Brushing

Resurfacing operations usually leave copper particles and slivers on the edges of the commutator bars and in the slots. These must be removed before the machine is placed in service as they could cause a flashover. Use a brush with stiff nylon bristles, a piece of fiberboard or a special tool ground to fit the slot, Fig. IV-41-B, C, and clean the slots thoroughly. Use a slot raking tool, Fig. IV-41-A, and break the sharp edges of the bars.

If resurfacing has produced considerable copper-drag on the bar edges, a "V" shaped slot-raking tool should be used to remove fins and ragged edges from the bars. Insert the point of the tool in the slot so the sides of the tool will scrape the edge of the bar on each side of the slot as the tool is dragged along the slot.

After the slots have been cleaned, it may be necessary to use very fine sandpaper or crocus cloth to remove small burrs and slivers from the edges of the bars. Don't use emery cloth.

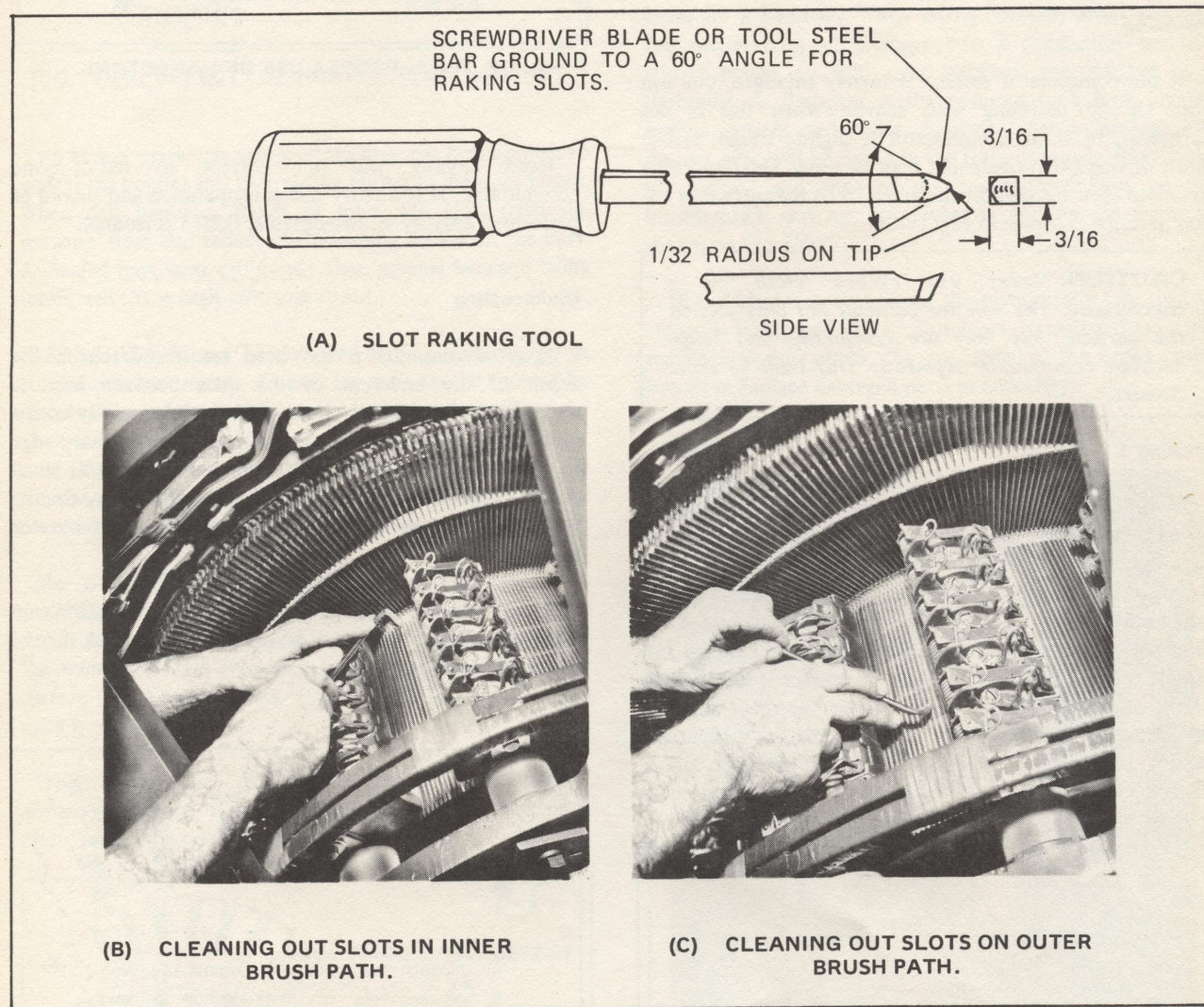


FIG. IV-41. CLEANING COMMUTATOR SLOTS.